

PATENT COOPERATION TREATY

PCT

INTERNATIONAL PRELIMINARY REPORT ON PATENTABILITY

(Chapter II of the Patent Cooperation Treaty)

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference PA136310/PCT	FOR FURTHER ACTION		See Form PCT/PEA416
International application No. PCT/IB2004/004069	International filing date (<i>day/month/year</i>) 10.12.2004	Priority date (<i>day/month/year</i>) 12.12.2003	
International Patent Classification (IPC) or national classification and IPC INV. C30B29/04 C03B29/04			
Applicant ELEMENT SIX LIMITED			
1. This report is the international preliminary examination report, established by this International Preliminary Examining Authority under Article 35 and transmitted to the applicant according to Article 36. 2. This REPORT consists of a total of 6 sheets, including this cover sheet. 3. This report is also accompanied by ANNEXES, comprising: a. <input checked="" type="checkbox"/> <i>sent to the applicant and to the International Bureau</i> a total of 5 sheets, as follows: <input checked="" type="checkbox"/> sheets of the description, claims and/or drawings which have been amended and are the basis of this report and/or sheets containing rectifications authorized by this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions). <input type="checkbox"/> sheets which supersede earlier sheets, but which this Authority considers contain an amendment that goes beyond the disclosure in the international application as filed, as indicated in item 4 of Box No. I and the Supplemental Box. b. <input type="checkbox"/> (<i>sent to the International Bureau only</i>) a total of (indicate type and number of electronic carrier(s)) , containing a sequence listing and/or tables related thereto, in electronic form only, as indicated in the Supplemental Box Relating to Sequence Listing (see Section 802 of the Administrative Instructions).			
4. This report contains indications relating to the following items: <input checked="" type="checkbox"/> Box No. I Basis of the report <input type="checkbox"/> Box No. II Priority <input type="checkbox"/> Box No. III Non-establishment of opinion with regard to novelty, inventive step and industrial applicability <input type="checkbox"/> Box No. IV Lack of unity of invention <input checked="" type="checkbox"/> Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement <input type="checkbox"/> Box No. VI Certain documents cited <input type="checkbox"/> Box No. VII Certain defects in the international application <input checked="" type="checkbox"/> Box No. VIII Certain observations on the international application			
Date of submission of the demand 11.10.2005		Date of completion of this report 13.04.2006	
Name and mailing address of the international preliminary examining authority: <div style="display: flex; align-items: center;"> <div> European Patent Office - P.B. 5818 Patentlaan 2 NL-2280 HV Rijswijk - Pays Bas Tel. +31 70 340 - 2040 Tx: 31 651 epo nl Fax: +31 70 340 - 3016 </div> </div>		Authorized officer Cook, S Telephone No. +31 70 340-3372	



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Box No. I Basis of the report

1. With regard to the **language**, this report is based on the international application in the language in which it was filed, unless otherwise indicated under this item.
 - ☐ This report is based on translations from the original language into the following language , which is the language of a translation furnished for the purposes of:
 - ☐ international search (under Rules 12.3 and 23.1(b))
 - ☐ publication of the international application (under Rule 12.4)
 - ☐ international preliminary examination (under Rules 55.2 and/or 55.3)
2. With regard to the **elements*** of the international application, this report is based on *(replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report)*:

Description, Pages

1-54 as originally filed

Claims, Numbers

1-49, 61-68 as originally filed
 50-60, 69-74 received on 07.11.2005 with letter of 31.10.2005

Drawings, Sheets

1/10-10/10 as originally filed

- ☐ a sequence listing and/or any related table(s) - see Supplemental Box Relating to Sequence Listing

3. ☐ The amendments have resulted in the cancellation of:
 - ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):
4. ☐ This report has been established as if (some of) the amendments annexed to this report and listed below had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).
 - ☐ the description, pages
 - ☐ the claims, Nos.
 - ☐ the drawings, sheets/figs
 - ☐ the sequence listing (*specify*):
 - ☐ any table(s) related to sequence listing (*specify*):

* If item 4 applies, some or all of these sheets may be marked "superseded."

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Box No. V Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Yes: Claims	1-53,63-67,69-71,73,74
	No: Claims	54-62,68,72
Inventive step (IS)	Yes: Claims	1-53
	No: Claims	54-74
Industrial applicability (IA)	Yes: Claims	1-74
	No: Claims	

2. Citations and explanations (Rule 70.7):

see separate sheet

Box No. VIII Certain observations on the international application

The following observations on the clarity of the claims, description, and drawings or on the question whether the claims are fully supported by the description, are made:

see separate sheet

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Re Item V

**Reasoned statement with regard to novelty, inventive step or industrial applicability;
citations and explanations supporting such statement**

Reference is made to the following documents:

D1: WO 03/014427 A (APOLLO DIAMOND, INC) 20 February 2003 (2003-02-20)

D2: LU T ET AL: "Characterization of a notable historic gem diamond showing the alexandrite effect" JOURNAL OF CRYSTAL GROWTH, NORTH-HOLLAND PUBLISHING CO. AMSTERDAM, NL, vol. 193, no. 4, 15 October 1998 (1998-10-15), pages 577-584, XP004144488 ISSN: 0022-0248

& D2' Product Information DiamondView™: (<http://www.gaiinstruments.co.uk/>)

Novelty

None of the known prior art documents describe the essential features of the independent claims 1 and 30.

The document D1 is regarded as being the closest prior art to the subject-matter of claims 1 and 30, and shows (the references in parentheses applying to this document): a method for forming synthetic monocrystalline diamond containing controlled doping. D1 suggests the possibility of growing diamond from normal isotope carbon and introducing layers of carbon-13 for the purpose of marking and identifying the CVD diamond (page 21). This prior art document does not teach introducing one or more chemical dopants to form a mark of origin or fingerprint. The subject matter of claims 1 and 30 and their dependent claims is thus novel with respect to D1 (Article 33(2) PCT).

The apparatus of independent claim 54 (and dependent claims 55-62, 68, 72) is not considered novel with respect to the DiamondView™ apparatus commercially available before the priority date of the present application. Reference is made to page 581 of D2 and the Internet product information sheet D2'. The subject matter of claim 54 contains no constructional features distinguishing it from this prior art means of imaging fluorescence patterns in a diamond. Choosing an appropriate wavelength to obtain the desired result (e.g. fluorescence in bulk of diamond), without the introduction of a specific constructional feature, does not establish novelty of the apparatus per se. Claim 54 does not therefore meet the requirements of Article 33(2) PCT.

Features establishing novelty of an apparatus can only be constructional features and not steps pertaining to its method of use. The subject matter of dependent claims 63-67, 69-71 and 73 contains such features.

Concerning the viewing method of independent claim 74, this is considered novel with respect to D2. D2 teaches viewing the characteristic features (i.e. fingerprint) of a historical diamond by directing light of a certain wavelength onto the diamond to cause excitation which is then imaged. The wavelength is chosen to illuminate the diamond surface as opposed to the bulk as is specified in claim 74. Novelty is thus established.

Inventive Step

The problem to be solved by the present invention may be regarded as finding a way to mark for identification purposes CVD diamond. Incorporating marks of origin or fingerprints in the bulk of CVD diamond by chemical doping as opposed to isotopic doping appears not to be suggested by the prior art. The subject matter of claims 1-53 is considered as involving an inventive step (Article 33(3) PCT).

Concerning the independent claims 54 (apparatus for detecting the mark) and 74 (viewing method) no inventive step can be acknowledged. Examining any object by means of irradiation of a given wavelength to detect internal or superficial characteristics of the object is well known throughout all fields of science and industry. Examining diamonds, either at their surface or in their bulk is also well known. The features of claims 54-73 (light source, filters and windows etc) and the method of claim 74 contains no constructional element or method step which would not be obvious to the person skilled in examining and analysing diamonds, be it the high-street jeweller or the research scientist. The subject matter of claims 54-74 therefore does not meet the requirements of Article 33(3) PCT.

Industrial applicability

The claimed subject matter is considered to be industrially applicable and thus fulfilling the requirements of Article 33(4) PCT.

Re Item VIII

Independent claim 30 does not meet the requirements of Article 6 PCT because it does not contain all the essential features clearly defining the product for which protection is sought. The chemical/ physical nature (defect centres associated with chemical dopants)

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of the mark of origin or fingerprint is missing from this claim.

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50. CVD single crystal diamond material according to any one of claims 30 to 49, which, under suitable illumination conditions, exhibits orange luminescence arising from 575 nm/637 nm N related defect centres and, under or after the same or other suitable illumination conditions, exhibits blue phosphorescence associated with donor acceptor pair recombination.
51. CVD single crystal diamond material according to any one of claims 30 to 50, which, under suitable illumination conditions, exhibits more than one discrete layer in which the ratio of the thicknesses of the layers is in accordance with a pre-determined pattern.
52. CVD single crystal diamond material according to claim 30, wherein the fingerprint or mark of origin comprises one or more layers free of defects with distinguishing properties embedded in a larger volume of material, which is marked by defects with distinguishing properties.
53. CVD single crystal diamond material according to any one of claims 30 to 52, wherein the fingerprint or mark of origin is used as or in the manner of a trademark.
54. An apparatus for detecting a mark of origin or fingerprint in a CVD single crystal diamond material bearing the mark of origin or fingerprint in the bulk thereof, the apparatus comprising:
- a body arranged to receive or hold CVD single crystal diamond material bearing the mark of origin or fingerprint in the bulk thereof;
 - a source of light or radiation arranged to direct the light or radiation at the CVD single crystal diamond material, the light or radiation being of a wavelength suitable for penetrating the volume of the CVD single crystal diamond material and causing

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excitation of the mark of origin or fingerprint resulting in luminescence and/or phosphorescence thereof to expose the mark of origin or fingerprint; and

a detection means for detecting the exposed mark of origin or fingerprint.

55. An apparatus according to claim 54, wherein the detection means comprises a viewer for viewing the luminescence and/or phosphorescence, or an instrument providing a measure of the intensity of the specific luminescence and/or phosphorescence.
56. An apparatus according to claim 55, wherein the measure of the intensity of the specific luminescence and/or phosphorescence is in the form of an analogue or digital electrical signal, or display readout.
57. An apparatus according to any one of claims 54 to 56, wherein the apparatus comprises a range of optical filters for viewing the wavelengths emitted by the mark of origin or fingerprint, and means for excluding background white light or wavelengths present which may be detrimental to observing the wavelengths emitted by the mark.
58. An apparatus according to any one of claims 54 to 57, further comprising magnification means for magnifying the exposed mark of origin or fingerprint in the CVD single crystal diamond material.
59. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite 575 nm and/or 637 nm luminescence.

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60. An apparatus according to claim 54, wherein the apparatus is arranged preferentially to excite blue band phosphorescence peaking in the region of 400 – 500 nm.

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69. An apparatus according to claim 68, wherein the source of light or radiation is a pulsed Xenon source.
70. An apparatus according to claim 68 or claim 69, wherein the source of light further comprises a filter to exclude wavelengths outside the range 225-275 nm.
71. An apparatus according to any one of claims 68 to 70, wherein an observer or detector is protected from UV radiation from the source of light or radiation by the use of a window, such as a glass or Perspex window, which absorbs UV in the range 225 – 275 nm.
72. An apparatus according to claim 62, wherein the source of light or radiation is selected to provide illumination in the range 480 – 700 nm.
73. An apparatus according to claim 72, wherein the source of light or radiation is a 633 HeNe laser.
74. A method of viewing or detecting a mark of origin or fingerprint in a CVD single crystal diamond material bearing the mark of origin or fingerprint in the bulk thereof, which mark of origin or fingerprint is not visible under normal viewing conditions, the method including the steps of:
- a. directing a source of light or radiation at the CVD single crystal diamond material, the light or radiation being of a wavelength suitable for penetrating the volume of the CVD single crystal diamond material and causing excitation of the mark of origin or fingerprint resulting in luminescence and/or phosphorescence thereof to expose the mark of origin or fingerprint; and

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- b. viewing or detecting the exposed mark of origin or fingerprint.